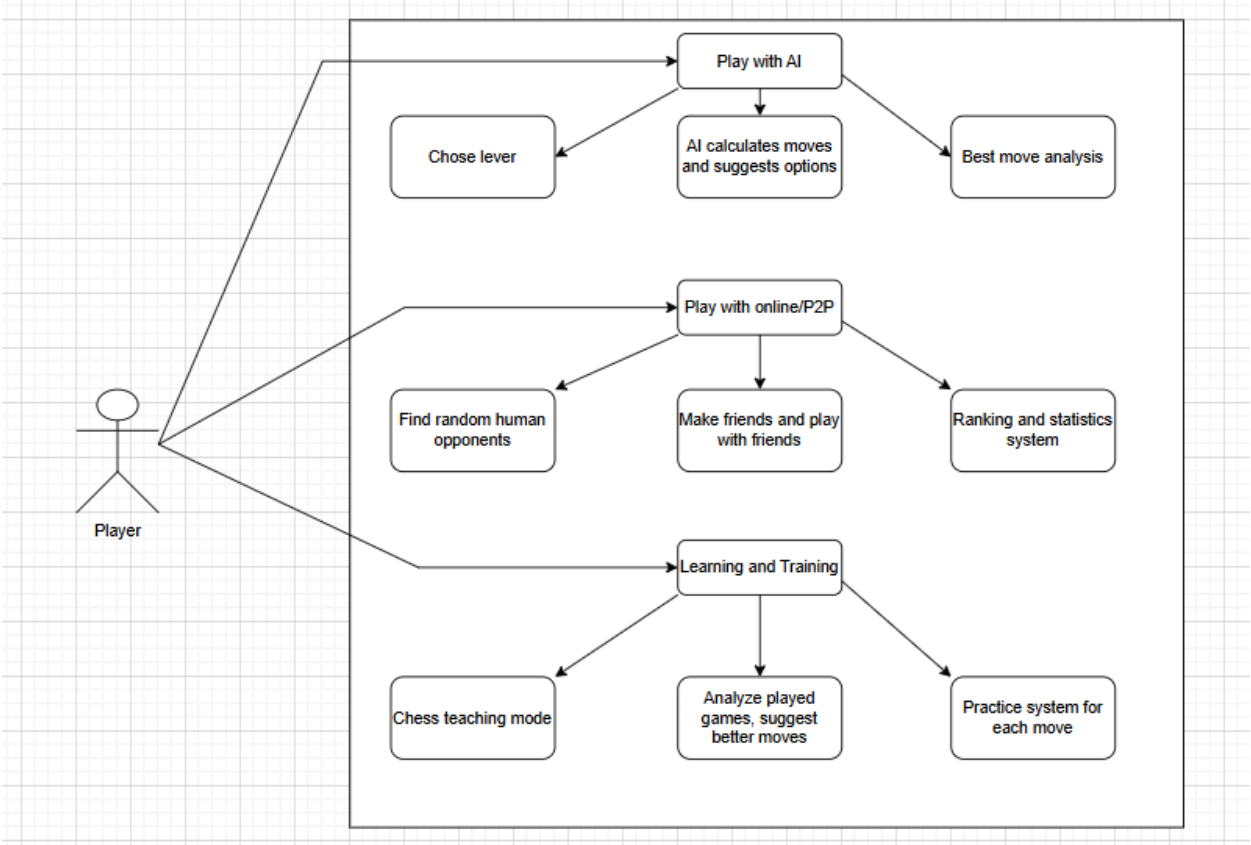
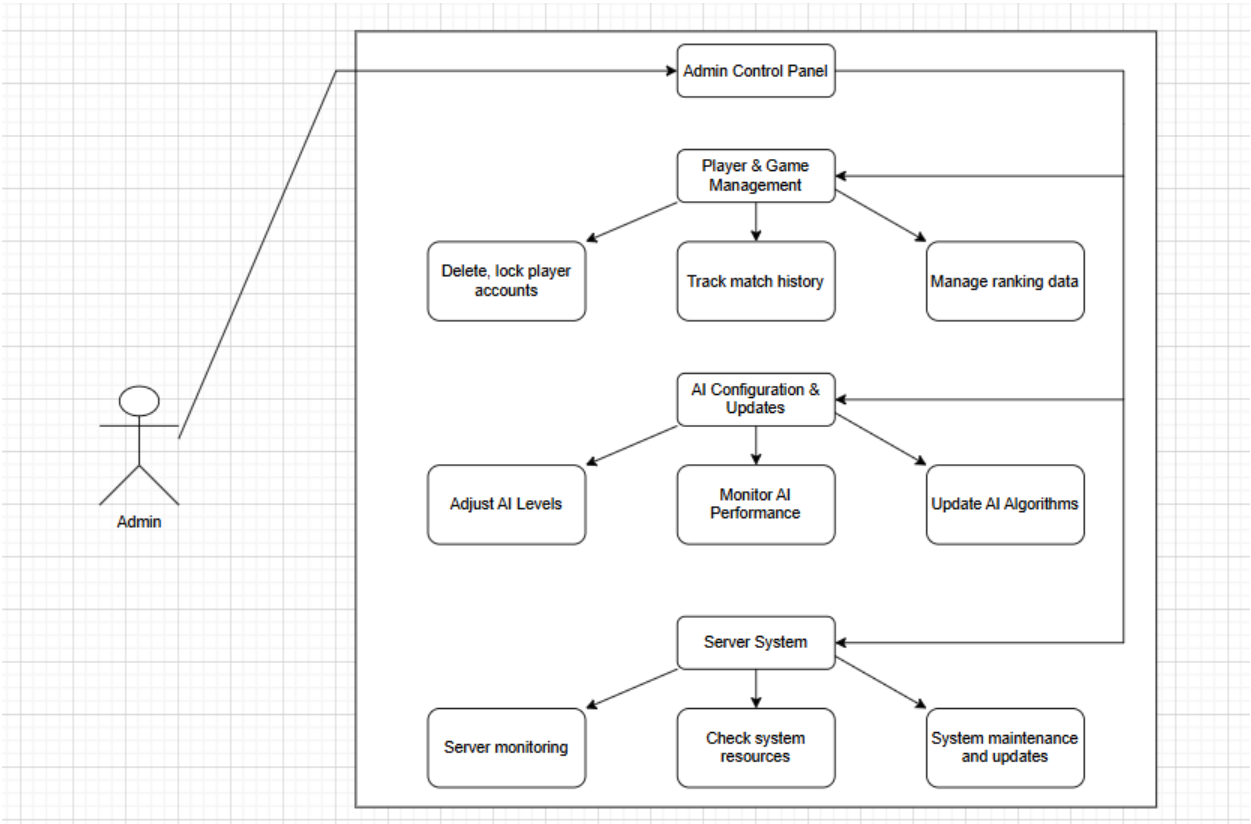
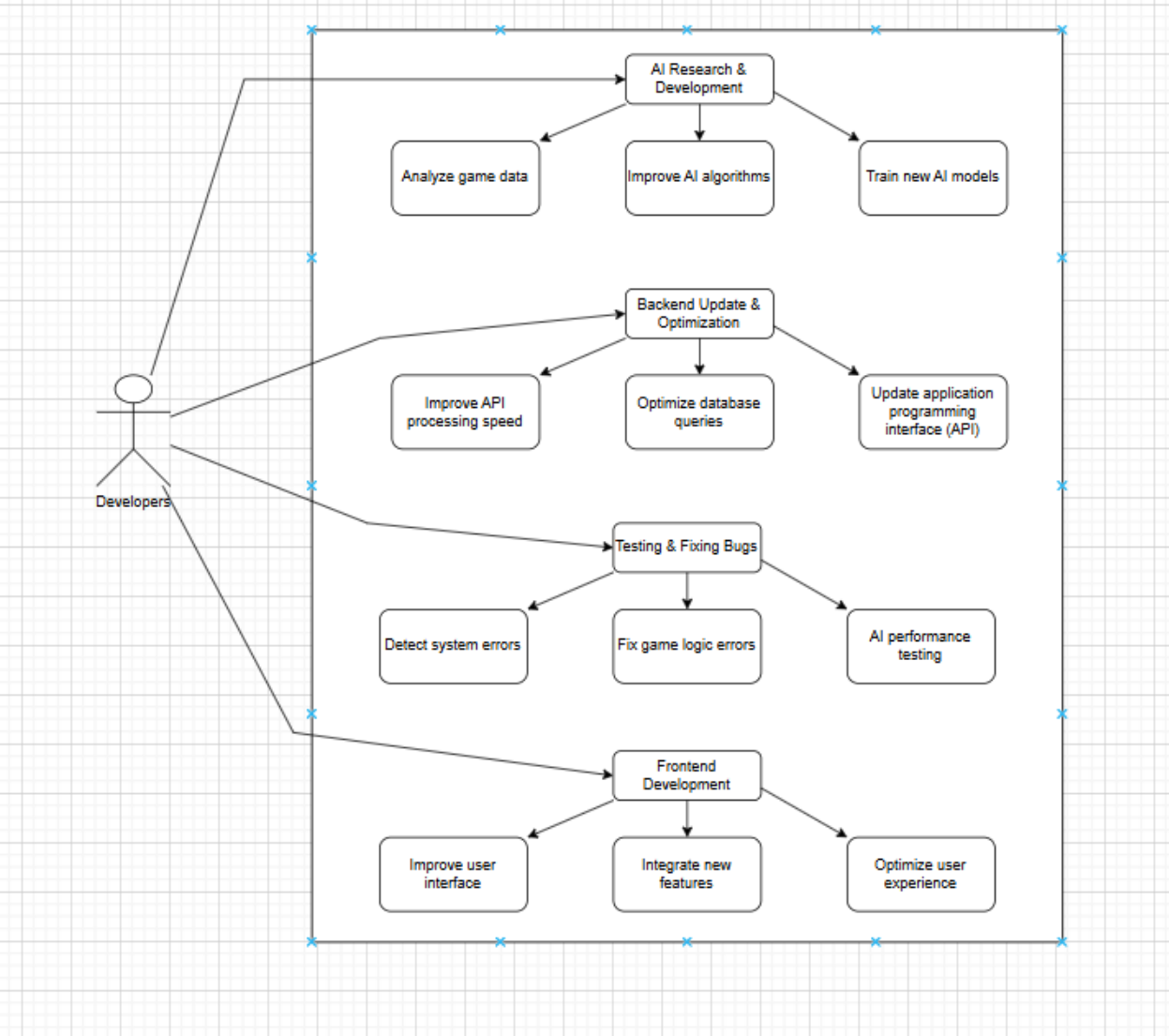

Player
Play with AI
Chose lever
AI calculates moves and suggests options
Best move analysis
Play with online/P2P
Find random human opponents
Make friends and play with friends
Ranking and statistics system
Learning and Training
Chess teaching mode
Analyze played games, suggest better moves
Practice system for each move


Admin
Admin Control Panel
Player & Game Management
Delete, lock player accounts
Track match history
Manage ranking data
AI Configuration & Updates
Adjust AI Levels
Monitor AI Performance
Update AI Algorithms
Server System
Server monitoring
Check system resources
System maintenance and updates



1. Introduction

1.1 Project Objective

The project aims to develop a Xiangqi game where players can compete against AI or other human players. The game will incorporate artificial intelligence to create an AI opponent with multiple difficulty levels, assisting users in training and improving their Xiangqi skills.

Detailed Analysis of Project Objectives:

1. **Developing a robust AI system capable of playing Xiangqi effectively**
    - Implementing advanced algorithms such as Monte Carlo Tree Search (MCTS) and Deep Reinforcement Learning.

- Training AI with historical Xiangqi game data to improve decision-making.
- Ensuring AI adapts dynamically to different playstyles.

2. **Supporting single-player mode against AI**
    - Providing multiple difficulty levels to cater to beginners and advanced players.
    - Allowing users to configure AI settings to customize gameplay experiences.
    - Implementing an AI coach mode that offers move suggestions.
3. **Supporting online multiplayer mode against real players**
    - Developing a matchmaking system that pairs players of similar skill levels.
    - Implementing a ranking and leaderboard system to encourage competition.
    - Ensuring real-time synchronization and low-latency gameplay.
4. **Analyzing and suggesting optimal moves to assist players**
    - Implementing move evaluation based on AI analysis.
    - Providing real-time suggestions and explanations for each move.
    - Allowing users to review past games with AI-generated insights.
5. **Creating a user-friendly interface**
    - Designing an intuitive UI/UX suitable for both beginners and advanced players.
    - Ensuring smooth and responsive gameplay across different devices.
    - Providing customizable themes and board layouts.
6. **Integrating a ranking system and tracking player achievements**
    - Developing an Elo-based ranking system for fair matchmaking.
    - Tracking player statistics such as win rate, best moves, and past game performance.
    - Implementing badges and achievements to encourage player engagement.

1.2 Project Scope

The project scope defines the key aspects and deliverables of the Xiangqi AI game, ensuring a structured and well-defined development process.

Detailed Analysis of Project Scope

1. **Developing a cross-platform Xiangqi application (PC, Mobile, Web)**

- Ensuring compatibility across different operating systems (Windows, macOS, Android, iOS, Web).
- Implementing a responsive and adaptive UI design for seamless experience across all platforms.
- Using a scalable architecture to accommodate different device capabilities.

2. **Supporting offline mode (playing against AI) and online mode (playing against other players over the Internet)**
    - Implementing local storage for offline play and seamless transition to online mode.
    - Ensuring smooth game progression with automatic reconnection in case of connectivity issues.
    - Allowing users to switch between AI and human opponents without losing game progress.
3. **Utilizing AI to analyze and recommend smart moves**
    - Developing an AI engine capable of real-time analysis and move recommendations.
    - Implementing an AI-based hints system to help players learn and improve.
    - Ensuring AI recommendations are explainable, allowing players to understand the logic behind each move.
4. **Providing a game history storage system and player skill assessment**
    - Implementing a cloud-based and local storage system for tracking past games.
    - Allowing players to replay past games with detailed AI analysis.
    - Providing statistics on player performance, strengths, and areas for improvement.
5. **Supporting multiple languages to reach a broader audience**
    - Implementing a multilingual user interface with easy language switching.
    - Supporting major languages to enhance global accessibility.
    - Ensuring all in-game content, including tutorials and AI explanations, are translated accurately.

2. System Description

2.1 Users

The system will have three main user groups:

Detailed Analysis of Users

1. **Players**
    - **Gameplay Experience:**
        - Play against AI at different difficulty levels.
        - Play against real players through an online matchmaking system.
        - Participate in tournaments, casual matches, and ranked matches.
    - **Training & Learning:**
        - Receive AI-powered suggestions for optimal moves.
        - Solve Xiangqi puzzles and complete training exercises.
        - Review game history and AI analysis to improve strategies.
    - **Customization & Personalization:**
        - Customize board themes, pieces, and user interface settings.
        - Build and manage a personal player profile.
        - Track individual progress and skill level using performance analytics.
    - **Social & Community Features:**
        - Chat with friends and opponents.
        - Join online clubs, communities, and tournaments.
        - Participate in leaderboards and ranked competitions.
2. **Administrators**
    - **User & Game Management:**
        - Monitor and moderate player activities.
        - Handle reports, disputes, and bans for rule violations.
        - Manage game history, rankings, and statistics.
    - **AI & System Configuration:**

        - Adjust AI difficulty levels and optimize performance.
        - Fine-tune matchmaking and ranking algorithms.
        - Oversee database storage and ensure game data integrity.
    - **Server & Security Maintenance:**
        - Manage server resources to ensure optimal performance.
        - Implement security measures to prevent cheating and fraud.
        - Monitor system logs and ensure stable operation.
3. **Developers**
    - **AI Development & Enhancement:**
        - Research and implement new AI algorithms to improve gameplay.
        - Train AI models with large datasets for better decision-making.
        - Optimize AI response times for real-time gameplay.
    - **Backend & System Optimization:**
        - Improve API performance and reduce latency.
        - Optimize database queries and backend processing.
        - Implement robust error-handling and crash recovery mechanisms.
    - **Bug Fixing & Feature Updates:**
        - Detect and resolve software bugs.
        - Develop new features based on player feedback.
        - Improve UI/UX for better accessibility and user satisfaction.

2.2 Additional Features

- **Tournament Mode** for competitive gameplay.
- **Puzzle Challenges** to train strategic thinking.
- **AI Coach Mode** for training and learning strategies.
- **Leaderboards & Achievements** to motivate players.

2.3 Core Features

AI-Powered Opponent

- **Adjustable Difficulty Levels:**
    - AI difficulty can be adjusted from beginner to expert.
    - Uses adaptive learning to improve based on past games.
- **AI Playstyles:**
    - Supports multiple AI personalities (aggressive, defensive, balanced).
    - Can analyze player weaknesses and adjust strategies accordingly.
- **AI Learning Mechanisms:**
    - Implements Monte Carlo Tree Search (MCTS) for move prediction.
    - Uses reinforcement learning to optimize decision-making over time.

Multiplayer Mode

- **Online Matchmaking:**
    - Matches players based on ranking and skill level.
    - Implements Elo rating system for fair competition.
- **Real-Time and Turn-Based Play:**
    - Supports both real-time games and correspondence chess with move timers.
    - Provides chat functionality and friend system for social play.
- **Anti-Cheating Mechanisms:**
    - AI-powered detection of suspicious move patterns.
    - IP tracking and fair play monitoring.

Game Analysis & Suggestions

- **Move Recommendations:**
    - AI suggests optimal moves based on board evaluation.
    - Provides alternative strategies for better decision-making.
- **Post-Game Analysis:**
    - Highlights key mistakes and suggests corrections.

    - Offers a replay system with AI commentary.
- **Historical Game Review:**
    - Allows players to revisit and study past matches.
    - Integrates with AI Coach Mode for targeted training.

User Customization

- **Themes & Board Designs:**
    - Players can choose different board styles and piece sets.
    - Custom themes available for accessibility options (e.g., high contrast mode).
- **Player Profiles & Statistics:**
    - Tracks game history, ranking, and performance.
    - Displays win/loss ratios, favored strategies, and playtime statistics.
- **Personalized Training Modes:**
    - Adaptive challenges based on player weaknesses.
    - AI-driven puzzles and scenarios for strategic improvement.

Cross-Platform Support

- **Multi-Device Compatibility:**
    - Available on Windows, macOS, Android, iOS, and Web.
    - Cloud-based game storage allows seamless play across devices.
- **Performance Optimization:**
    - Uses WebSockets for low-latency online gameplay.
    - Lightweight design to ensure smooth performance on all platforms.

2.4 Player Use Cases

Use Case ID	Name	Description
UC-001	Play Against AI	Player selects AI difficulty and plays a game against the AI.

UC-002	Play Online (P2P)	Player connects to an online game and competes against another human.
UC-003	Training Mode	Player engages in a guided training session to improve skills.
UC-004	Game Analysis	AI reviews a finished game and suggests optimal moves.
UC-005	Join Tournament	Player participates in an online tournament.
UC-006	Solve Chess Puzzles	Player practices solving tactical problems.

2.5 Administrator Use Cases

Use Case ID	Name	Description
UC-101	Manage Player Accounts	Admin can delete or lock player accounts.
UC-102	Monitor Match History	Admin can track player matches and statistics.
UC-103	Update AI Algorithms	Admin can adjust AI levels and update algorithms.
UC-104	Server Maintenance	Admin ensures smooth operation of the game servers.
UC-105	Moderate Online Chat	Admin can review and moderate player communication.

2.6 Developer Use Cases

Use Case ID	Name	Description
UC-201	Improve AI Algorithm	Developers optimize AI for better gameplay.
UC-202	Optimize Database	Improve database efficiency for game storage.
UC-203	Fix Game Bugs	Identify and resolve game errors.
UC-204	Enhance UI/UX	Improve the user interface for better experience.
UC-205	Improve Matchmaking	Optimize the player matchmaking system.
UC-206	Implement New Features	Add new gameplay modes and updates.

2.7 Functional Requirements

- Players must be able to play against AI with adjustable difficulty levels.
- Online multiplayer mode must support matchmaking, chat, and ranking systems.
- AI should analyze games and provide move suggestions.
- Users should be able to participate in tournaments and solve puzzles.
- Admins should manage player accounts, AI settings, and server maintenance.
- Developers should be able to update AI algorithms and optimize performance.
- The system must include a training mode with guided tutorials.
- Match history and game analysis features must be available to all users.
- A leaderboard and ranking system should be implemented.

2.8 Non-Functional Requirements

- The game should have a user-friendly and responsive UI.
- Performance should be optimized for smooth gameplay with minimal latency.
- The system must be scalable to support a large number of users.
- Security measures must be in place to protect user data and prevent cheating.
- The AI should continuously improve using machine learning techniques.
- The game should be accessible across multiple platforms (PC, mobile, web).
- The system should provide real-time updates and smooth animations.
- Server uptime should be maintained at 99.9% for continuous availability.